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Response of coriander varieties to various levels of fertility under different cutting management

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Abstract

An investigation was carried with an objective to work out the optimum fertilizer dose under different cutting management system for different varieties at Seed Spices Research Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, during *rabi* 2015-16 to 2017-18. The soil was loamy sand in texture, neutral in soil reaction, with low in organic carbon, medium in available phosphorus and potash. The treatments comprised of two varieties V_1: GDLC-1 and V_2: GCo-2, three cutting management levels M_1: No cutting (Top dressing at 30 DAS), M_2: One cutting at 40 – 45 DAS (T.D. after first cut) and M_3: Two cutting at 40–45 DAS and 60-65 DAS (T.D. after each cut) in main plot and three fertility levels *viz.*, F_1:20:10:00 kg NPK ha^{-1}, F_2: 40:20:00 kg NPK ha^{-1} and F_3: 60:30:00 kg NPK ha^{-1} in sub plot were replicated thrice in split plot design. All the growth and yield attributing characters of coriander were significantly influenced by cutting management, varieties and fertility levels on pooled basis. Cutting management, varieties and fertility levels affected significantly on coriander seed equivalent yield. One cutting at 45 DAS recorded significantly the higher coriander seed equivalent yield during course of investigation and on pooled basis over rest of the treatments. Variety GDLC-1 proved significantly superior than GCo-2 and produced higher coriander seed equivalent yield during individual as well as on pooled basis. Application of 60:30:00 kg NPK ha^{-1} produced significantly the highest coriander seed equivalent yield during individual years as well as on pooled basis. Interaction effect of cutting management, variety and fertility levels was found significant on coriander seed equivalent yield. Variety GDLC-1 cultivated by adopting two cutting at 40-45 DAS and 60-65 DAS (T.D. after each cut) supplemented the 60:30:00 kg NPK ha^{-1} recorded significantly the highest seed yield over rest of the variety, cutting and fertility levels combinations. Variety GDLC-1 adopted with one cutting at 40 - 45 DAS (T.D. after first cut supplemented 60:30:00 kg NPK ha^{-1} achieved higher net realization (Rs.1,21,558/- ha^{-1}) and BCR (3.2) value than rest of the combinations.

Introduction

Coriander (*Coriandrum sativum* L.) is one of the most important spice crops belongs to Apiaceae family. It is commonly known as "Dhania" or "Dhana". Coriander is one of the few plants which can be termed both as herb and spice, the seeds being used as spices and leaves are widely used as herbs and dietary purpose. This is the most widely used plant in both forms. The tender leaves, stem and fruits of coriander have a pleasant aromatic flavour and thus is indispensable food adjunction in Indian cookery. The seeds are also used as condiment. The medicinal properties of coriander are many used in Indian Ayurvedic and Unani medicinal preparation. Coriander leaves are the rich source of vitamin A and C. The green herbs contain vitamin C up to 160 mg 100 g^{-1} and vitamin A up to 12 mg 100 g^{-1} (Girenko, 1982). Coriander plant has regenerative capacity and hence 2-3 cuttings can be undertaken very easily. Menon and Khader (1997) and Thapa (1999) suggested that leaf plucking of coriander seed crop at early stages can provide an extra income to the growers. The aromatic odour in coriander is due to the presence of essential oil, which has been reported to range from 0.1 to 1.0 per cent in dry seed of varieties of different origin. Coriander oil is the value-added product used in flavoring food, pharmaceuticals and perfumery. Coriander seeds has numerous medicinal properties such as antidyspectic, diuretic, sedative hypotonic, muscle relaxant. It is reported to use in treatment of chronic ulcer, sore throat, syphilis and sunstroke (Mahatma *et al.,* 2022). In spite of its wide cultivation in India, the average seed yield of coriander is rather low because lack of attention given to this crop. Use of improved varieties/cultivars is one of the strategies for increasing the production and productivity of the crop. Among the varietal revolution certain varieties are focused for seed purpose others may be sown for green leaf biomass production. Both the varieties have their own performance and importance in human diet. For leaf purpose, coriander is grown all the year round. To reduce the risk and increase the income in short period, farmer grows the coriander for dual purposes *i.e.* green vegetable as well as seed. Selection of variety according to cutting management is the non-cash input for increasing the income of farmers. Nitrogen has a considerable effect, not only on quality of produce but on quantity of produce also. It is involved in photosynthesis, respiration and protein synthesis. It imparts the dark green colour of the leaves, promotes vigorous vegetative growth and more efficient use of available inputs finally leads to higher productivity. Deficiency of nitrogen cause yellowish of lower leaves, stunted plant growth and shadings of leaves as well as fruits might be responsible for poor yield. Whereas, excess application of nitrogen is responsible for luxurious shoot growth which makes plant more susceptible to pest and diseases. Phosphorus plays a pivotal structure and regulatory role at the nexus of photosynthesis, root development, energy conservation and transformation, carbon metabolism, redox activation signaling reactions and enzyme nucleic acid synthesis. It also has a significant role in sustaining and building up soil fertility, particularly under intensive systems of agriculture, but it is one of the most immobile, inaccessible and unavailable nutrients presents in the soil. Phosphorus fertilization increased the vegetative growth, essential oil, fixed oil, total carbohydrates, soluble sugars and NPK content of some Apiaceae (Anis, Coriander and Sweet fennel). The agronomic efficiency of N decreased with increasing N rate and seed yield increased with the increased in P2 O rate, from 20 to40 kg ha^{-1} and reduce thereby (Channabasvanna, 2002). In Karnataka, 60:40:20 kg NPK ha^{-1} was found optimum for growth and yield of crop (Channabasvanna *et al.,* 2002). N and P application enhanced the yield and nutrient uptake and also P and organic carbon content in soil (Tiwari and Banafar, 1995). High yielding coriander varieties are very specific in their nutritional requirement and also need very judicious use of fertilizer to exploit their genetic yield potential, boosting up fertilizer use efficiency and large scale adoption in under developed regions. The variety Gujarat Dantiwada Leafy Coriander -1 (GDLC–1) recently released at seed spices research station for leaf purpose have potentiality to produce high green leaf biomass by adopting three cuts. The foliage of the crop is cut

arbitrarily by the farmers several times and is sold in the market. Thereafter, the crop is left for seed production. For its economization number of cuttings needs to be worked out as both the under and over-cutting may lead to poor seed production and returns Hence, present experiment was conducted to find out the suitable variety with optimum fertilizer dose for coriander under multi cut management practices.

Materials and methods

An investigation was carried with an objective to work out the optimum fertilizer dose under different cutting management system for different varieties at Seed Spices Research Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, during *rabi* 2015-16 to 2017-18. Soil texture was loamy sand in nature with low in organic carbon (0.18 %) and low in nitrogen (135 kg N ha^{-1}) as well as medium in available phosphorus (36 Kg P_2O_5 ha^{-1}) and potassium (285 kg K_2O ha^{-1}). The treatments comprised of two varieties V_1: GDLC-1 and V_2: GCo-2, three cutting management levels M_1 : No cutting (Top dressing at 30 DAS),M_2 : One cutting at 40 – 45 DAS (T.D. after first cut) and M_3 : Two cutting at 40 – 45 DAS and 60-65 DAS (T.D. after each cut) in main plot and three fertility levels *viz*., F_1: 20:10:00 kg NPK ha^{-1}, F_2 : 40:20:00 kg NPK ha^{-1} and F_3 : 60:30:00 kg NPK ha^{-1} in sub plot were replicated thrice in split plot design. The variety GDLC-1 was released in the year 2014 for leaf purpose from seed spices research station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan. The leaves are dark green in color with shinning, soft and high aroma. The variety responded well even under more cutting due to late bolting, first cutting after 40-45 DAS, second at after 60-65 DAS and third is at around 80-85 DAS and further it left for seed production. It produces around 30 t green leaf per hectare. The cuttings of green leaf for the variety GDLC-1 were made as per treatments and also produce the seed yield in respective treatments. Whereas, seed yield and green leaf biomass were recorded according to treatments. Full dose of phosphorus and half of nitrogen apply as basal and remaining half dose of nitrogen apply as top dressing as per cutting management treatments. The seeds (fruits) were rubbed for separating the two mericarps (seeds) and were soaked in water for 24 hours to enhance germination. Seed were also treated with bavistin at 2g kg^{-1} of seeds before sowing. Recommended package of practices was followed to get the good crop condition according to variety. Data were recorded on plant height, number of branches, umbels per plant, umbellets per umbel, seeds per umbel, seed yield, green leaf yield and essential oil content. For convenience in statistical calculation and interpretation, the yield of varieties was converted in to coriander seed equivalent yield (Kg ha^{-1}). The data were pooled for all the three years and statistically analyzed for different characters as suggested by Panse and Sukhatme. To ascertain the economic feasibility of different treatments, economics of the treatments was worked out by calculating parameters like cost of cultivation, gross returns, net returns and benefit cost ratio using the prevailing price of inputs and output in the local market.

Results and discussion

All the growth and yield attributing characters of coriander (Table 1) were significantly influenced by cutting management, varieties and fertility levels on pooled basis. No cutting recorded significantly the highest values of growth and yield attributing characters over cutting adopted once and twice. The results are in line with results reported by Baboo (1995) for growth and yield attributing characters. Variety GDLC-1 confirmed significantly highest values of all the growth and yield attributing characters over GCo-2 except, number of seeds per umbellate on pooled basis. Both the higher fertility levels were remained at par and produced significantly higher growth and yield attributing characters over lower fertility level on pooled basis. Baboo and Rana (1995) revealed that higher nitrogen application at 90 kg ha^{-1} produced significantly higher growth attributing characters. This might be due to adequate supply of nitrogen associated with high photosynthetic activity leading to vigorous vegetative growth and physiologically more stout and healthy plant morphology. The results of the present investigations

are in close agreement with the findings of Randhawa *et al.* (1978), Baboo and Rana (1995), Moniruzzaman *et al.* (2005), Ughreja (1992), Ghosh (2009) and Javiya *et al.* (2017).

Cutting management, varieties and fertility levels affected significantly on coriander seed equivalent yield (Table 2). One cutting at 45 DAS recorded significantly the higher coriander seed equivalent yield during course of investigation and on pooled basis over rest of the treatments. Guha, *et al.* (2013) reported that among different levels of cutting the highest leaf yield was found in two cutting, while seed yield was more under one cut in pot culture experiment. Baboo and Rana (1995) also reported that crop left for seed production after one cut at 30 days gave significantly higher seed yield than others in both the seasons.

Variety GDLC-1 proved significantly superior than GCo-2 and produced higher coriander seed equivalent yield during individual as well as on pooled basis (Table 2).

Application of 60:30:00 kg NPK ha^{-1} produced significantly the highest coriander seed equivalent yield during individual years as well as on pooled basis (Table 2). This might be due to adequate supply of nitrogen associated with high photosynthetic activity resulted in vigorous plant growth. Higher seed yield in this treatment might be attributed to more branching, leading to a greater number of umbels per plant. The results of the present investigations are in close agreement with the findings of Randhawa *et al.* (1978), Baboo (1995), Moniruzzaman *et al.* (2005), Ughreja and Cundawat (1992), Ghosh (2009) and Javiya *et al.* (2017) for different crops when applied higher nitrogen dose.

Interaction effect of cutting management and variety on coriander seed equivalent yield found significant (Table 3). Variety GDLC-1 responded well and produced significantly higher coriander seed equivalent yield over rest of the treatment combinations except followed with one cutting at 45 DAS.

Application of maximum dose of fertilizer at one cutting recorded significantly the highest coriander seed equivalent yield of 2043 kg ha^{-1} over rest of the treatment combinations (Table 4). Thus, application of 60:30:00 kg NPK ha^{-1} was optimum doses of fertilizer for dual purpose coriander. Baboo and Rana (1995) revealed that higher nitrogen N 90 kg ha^{-1} and one cutting 45 DAS recorded significantly higher coriander seed yield. This might be due to adequate supply of nitrogen associated with high photosynthetic activity leading to vigorous vegetative growth and physiologically more stout and healthy plant morphology.

Variety GDLC-1 responded significantly better at higher fertility levels and produced significantly the highest coriander seed equivalent yield (Table 5). Significant response on equivalent seed yield was recorded with increase in each fertility level for the variety GDLC-1. Aishwath (2016) reported that fertilizer recommendation for a particular crop depends on the varieties chosen for cultivation at a particular location. In coriander, response of N was found up to 100 kg ha^{-1} observed depending upon varieties, because uptake of NPK was always higher in straw than the seed and that can be utilized for recycling of nutrients. The results are also in line with the results reported from Diwan *et al.* (2018).

Interaction effect of cutting management, variety and fertility levels was found significant on coriander seed equivalent yield (Table 6). Variety GDLC-1 cultivated by adopting two cutting at 40-45 DAS and 60-65 DAS (T.D. after each cut) supplemented the 60:30:00 kg NPK ha^{-1} recorded significantly the highest seed yield over rest of the different variety, cutting and fertility levels combinations.

Effect of different factors on economics is depicted in Table 7 shows that among different cutting management practices one cutting at 40–45 DAS (T.D. after first cut) recorded higher net realization (Rs. 90,301/-) and BCR (2.5) value. Variety GDLC-1 confirmed higher net realization (Rs. 71,587/-) and BCR (2.0) values, whereas fertility level 60:30:00 kg NPK ha^{-1} accrued higher net realization of Rs. 72,313/- with BCR value of 1.9.

Effect of cutting management, varieties and fertility indicated in Table 8 shows that variety GDLC-1 adopted with one cutting at 40-45 DAS (T.D. after first cut supplemented 60:30:00 kg NPK ha^{-1} achieved

Table 1. Growth and yield attributing characters as influenced by cutting management, varieties and fertility levels(Pooled)

Treatments		Plant height (cm)	Number of branches	Number of umbels plant^{-1}	Number of umballates umbel^{-1}	Number of seed	Test weight (g)
Main plot : Cutting management							
No cutting (Top dressing at 30 DAS)		104.4	5.2	25.0	4.8	7.0	8.60
One cutting at 40-45 DAS (T.D. after first cut)		77.3	3.3	15.8	3.9	6.6	8.16
Two cutting at 40-45 DAS and 60-65 DAS (T.D.after each cut)		47.5	2.4	9.8	3.3	4.6	7.74
	S. Em. ±	1.3	0.1	0.5	0.07	0.1	0.03
	C.D. at 5 %	3.7	0.3	1.5	0.22	0.4	0.08
Main plot : Variety							
GDLC-1		82.2	3.9	19.5	12.5	6.1	6.73
GCo-2		70.5	3.3	14.2	11.5	6.0	9.59
	S. Em. ±	1.05	0.1	0.42	0.06	0.12	0.02
	C.D. at 5 %	4.1	0.3	1.67	0.24	NS	0.08
	C.V.(%)	13.66	21.82	22.65	13.77	18.00	2.34
Cutting management x Variety		S	S	NS	S	S	S
Sub plot : Fertility levels							
20:10:00 kg NPK ha^{-1}		73.3	3.5	16.0	11.2	5.9	8.01
40:20:00 kg NPK ha^{-1}		77.3	3.6	16.9	12.3	6.1	8.11
60:30:00 kg NPK ha^{-1}		78.6	3.8	17.6	12.4	6.2	8.37
	S. Em. ±	0.68	0.1	0.3	0.1	0.09	0.03
	C.D. at 5 %	1.9	0.3	0.9	0.2	0.3	0.08
	C.V.(%)	7.14	18.56	13.67	15.74	10.91	2.47
Cutting management x Fertility levels		NS	NS	NS	NS	S	S
Variety x Fertility levels		S	S	NS	NS	NS	S
Cutting management x Variety x Fertilitylevels		NS	NS	NS	S	NS	NS
Y x T		NS	NS	NS	NS	NS	NS

Table 2. Coriander seed equivalent yield (kg ha^{-1}) as influenced by different cutting management, variety and fertility levels

Treatments	Coriander seed equivalent yield (Kg ha^{-1})			
	2015-16	**2016-17**	**2017-18**	**Pooled**
Main plot : Cutting management				
No cutting (Top dressing at 30 DAS)	984	704	913	867
One cutting at 40–45 DAS (T.D. after first cut)	1702	1854	1885	1813
Two cutting at 40–45 DAS and 60-65 DAS (T.D.after each cut)	1531	1706	1718	1652
S. Em. ±	33	31	31	18
C.D. at 5 %	104	98	97	53
Main plot : Variety				
GDLC-1	1502	1516	1633	1550
GCo-2	1310	1326	1377	1338
S. Em. ±	27	25	25	15
C.D. at 5 %	85	80	79	59
C.V.(%)	9.98	9.30	8.66	9.30
Cutting management x Variety	S	S	S	S
S. Em. ±	47	44	43	26
C.D. at 5 %	147	139	137	102
C.V.(%)	9.98	9.30	8.66	9.30
Sub plot : Fertility levels				
20:10:00 kg NPK ha^{-1}	1268	1290	1353	1296
40:20:00 kg NPK ha^{-1}	1431	1446	1521	1466
60:30:00 kg NPK ha^{-1}	1519	1549	1641	1570
S. Em. ±	28	17	23	13
C.D. at 5 %	82	48	68	38
C.V.(%)	8.45	4.95	6.55	6.78
Cutting management x Fertility levels	S	S	S	S
S. Em. ±	49	29	40	23
C.D. at 5 %	142	84	117	65
Variety x Fertility levels	S	S	S	S
S. Em. ±	40	23	33	19
C.D. at 5 %	142	68	96	53
Cutting management x Variety x Fertility levels	NS	NS	NS	S
S. Em. ±	69	40	57	33
C.D. at 5 %	--	--	--	92
C.V.(%)	8.45	4.95	6.55	6.78
Y x T	-	-	-	NS

Interaction effect

Table 3. Interaction effect of cutting management and variety on coriander seed equivalent yield (Kg ha^{-1}) on pooled basis

Treatments	Coriander seed equivalent yield (Kg ha^{-1})	
	GDLC -1	**GCo -2**
No cutting (Top dressing at 30 DAS)	712	1022
One cutting at 40–45 DAS (T.D. after first cut)	1957	1670
Two cutting at 40–45 DAS and 60-65 DAS (T.D.after each cut)	1982	1321
S.Em ±	26	
C.D. at 5 %	102	
C.V %	9.30	
Y x T	NS	

Table 4. Interaction effect of cutting and fertility levels on coriander seed equivalent yield (Kg ha^{-1}) on pooled basis

Treatments	Coriander seed equivalent yield (Kg ha^{-1})		
	20:10:00 kg NPK ha^{-1}	**40:20:00 kg NPK ha^{-1}**	**60:30:00 kg NPK ha^{-1}**
No cutting (Top dressing at 30 DAS)	809	933	859
One cutting at 40 –45 DAS (T.D. after first cut)	1621	1776	2043
Two cutting at 40 –45 DAS and 60 -65 DAS (T.D. after each cut)	1459	1688	1807
S.Em ±		23	
C.D. at 5 %		65	
C.V %		6.78	
Y x T		NS	

Table 5. Interaction effect of variety and fertility levels on coriander seed equivalent yield (Kg ha^{-1}) on pooled basis

Treatments	Coriander seed equivalent yield (Kg ha^{-1})		
	20:10:00 kg NPK ha^{-1}	**40:20:00 kg NPK ha^{-1}**	**60:30:00 kg NPK ha^{-1}**
GDLC -1	1364	1565	1722
GCo-2	1228	1367	1418
S. Em.		19	
CD		53	
CV %		6.78	
Y x T		**NS**	

Table 6. Interaction effect of cutting management, variety and fertility levels on coriander seed equivalent yield (Pooled)

Coriander seed equivalent yield (Kg ha^{-1})				
Treatments		**20:10:00 kg NPK ha^{-1}**	**40:20:00 kg NPK ha^{-1}**	**60:30:00 kg NPK ha^{-1}a**
Cutting management	**Varieties**			
No cutting (Top dressing at 30 DAS)	GDLC-1	623	790	722
No cutting (Top dressing at 30 DAS)	G-Co-2	994	1076	995
One cutting at 40 -45 DAS (T.D. after first cut)	GDLC-1	1729	1868	2273
One cutting at 40 -45 DAS (T.D. after first cut)	GCo-2	1512	1684	1813
Two cutting at 40 -45 DAS and 60-65 DAS (T.D. after each cut)	GDLC-1	1740	2036	2170
Two cutting at 40 -45 DAS and 60-65 DAS (T.D. after each cut)	GCo-2	1179	1340	1445
S.Em ±			33	
C.D. at 5 %			92	
C.V %			6.78	
Y x T			NS	

Table 7. Economics as influenced by cutting management, varieties and fertility levels

Treatments	**Yield**	**Gross realization (Rs ha^{-1})**	**Cost of cultivation**	**Net realization (Rs ha^{-1})**	**BCR**
Main plot : Cutting management					
No cutting (Top dressing at 30 DAS)	867	60,675	34,794	25,880	0.7
One cutting at 40 –45 DAS (T.D. after first cut)	1813	1,26,944	36,642	90,301	2.5
Two cutting at 40 –45 DAS and 60 -65 DAS (T.D. after each cut)	1652	1,15,611	38,490	77,120	2.0
Main plot : Variety					
GDLC-1	1550	1,08,500	36,642	71,857	2.0
GCo-2	1338	93,660	36,642	57,017	1.6
Sub plot :Fertility levels					
20:10:00 kg NPK ha^{-1}	1296	90,720	35,703	55,016	1.5
40:20:00 kg NPK ha^{-1}	1466	1,02,620	36,638	65,981	1.8
60:30:00 kg NPK ha^{-1}	1570	1,09,900	37,586	72,313	1.9

Table 8. Interaction effect of cutting management, variety and fertility levels on economics.

Treatments			Net realization (Rs. ha^{-1}) and BCR		
			20:10:00 kg NPK ha^{-1}	40:20:00 kg NPK ha^{-1}	60:30:00 kg NPK ha^{-1}
No cutting (Top dressing at 30 DAS)	GDLC-1	Net realization	9,779	20,475	14,783
		BCR	0.3	0.6	0.4
No cutting (Top dressing at 30 DAS)	GCo-2	Net realization	35,751	40,556	33,938
		BCR	1.1	1.2	0.9
One cutting at 40 -45 DAS (T.D. after first cut)	GDLC-1	Net realization	85,361	94,148	1,21,558
		BCR	2.4	2.6	3.2
One cutting at 40 -45 DAS (T.D. after first cut)	GCo-2	Net realization	70,153	81,243	89,347
		BCR	2.0	2.2	2.4
Two cutting at 40 -45 DAS and 60-65 DAS (T.D.after each cut)	GDLC-1	Net realization	84,243	1,04,036	1,12,453
		BCR	2.2	2.7	2.9
Two cutting at 40 -45 DAS and 60-65 DAS (T.D.after each cut)	GCo-2	Net realization	44,960	55,333	61,700
		BCR	1.2	1.4	1.6

higher net realization (Rs.1,21,558/- ha^{-1}) and BCR (3.2) value than rest of the combinations. Baboo and Rana (1995) reported that one cut at 30 days gave higher net return.

Conflict of interest: The authors declare no conflict of interest.

Conclusion

Thus from the yield and economic point of view, it is concluded that for securing higher coriander seed equivalent yield and net returns, the coriander *Cv.* GDLC-1 with one cutting at 40-45 DAS and supplemented 60:30:00 kg NPK ha^{-1} as full dose of phosphorus and half dose of nitrogen as basal as well as remaining half dose of nitrogen after first cut *i.e.* 40-45 DAS should be applies.

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